1.6 MASS ABSORPTION COEFFICIENTS

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Mass absorption coefficients have been tabulated for elements Z = 1–92, based on both measured values and theoretical calculations [See B. L. Henke, E. M. Gullikson, and J. C. Davis, "X-Ray Interactions: Photoabsorption, Scattering, Transmission, and Reflection at E = 50–30,000 eV, Z = 1–92," *At. Data Nucl. Data Tables* **54,** 181 (1993). For updated information and calculations, see http://www-cxro.lbl.gov/optical_constants/.]. The mass absorption coefficient μ (cm^2/g) is related to the transmitted intensity through a material of density ρ (g/cm^3) and thickness d by

$$I = I_o e^{-\mu\rho d} \quad . \tag{1}$$

Thus, the linear absorption coefficient is $\mu_{\cdots}$ (cm^{-1}) = $\mu\rho$. For a pure material, the mass absorption coefficient is directly related to the total atomic absorption cross section σ_a (cm^2/atom) by

$$\mu = \frac{N_A}{A}\sigma_a \quad , \tag{2}$$

where N_A is Avogadro's number and A is the atomic weight. For a compound material, the mass absorption coefficient is obtained from the sum of the absorption cross sections of the constituent atoms by

$$\mu = \frac{N_A}{MW}\sum_i x_i \sigma_{ai} \quad , \tag{3}$$

where the molecular weight of a compound containing x_i atoms of type i is $MW = \Sigma_i\, x_i A_i$. This approximation, which neglects interactions among the atoms in the material, is generally applicable for photon energies above about 30 eV and sufficiently far from absorption edges.

In Fig. 1-5, the mass absorption coefficient is plotted for 15 elements over the photon energy range 10–30,000 eV. In much of this range, the absorption coefficient is dominated by photoabsorption. However, for H, Be, C, N, and O, Compton (inelastic) scattering is significant at the higher energies. In these cases, the total cross section is shown as a solid curve and the photoabsorption cross section as a separate dashed curve.

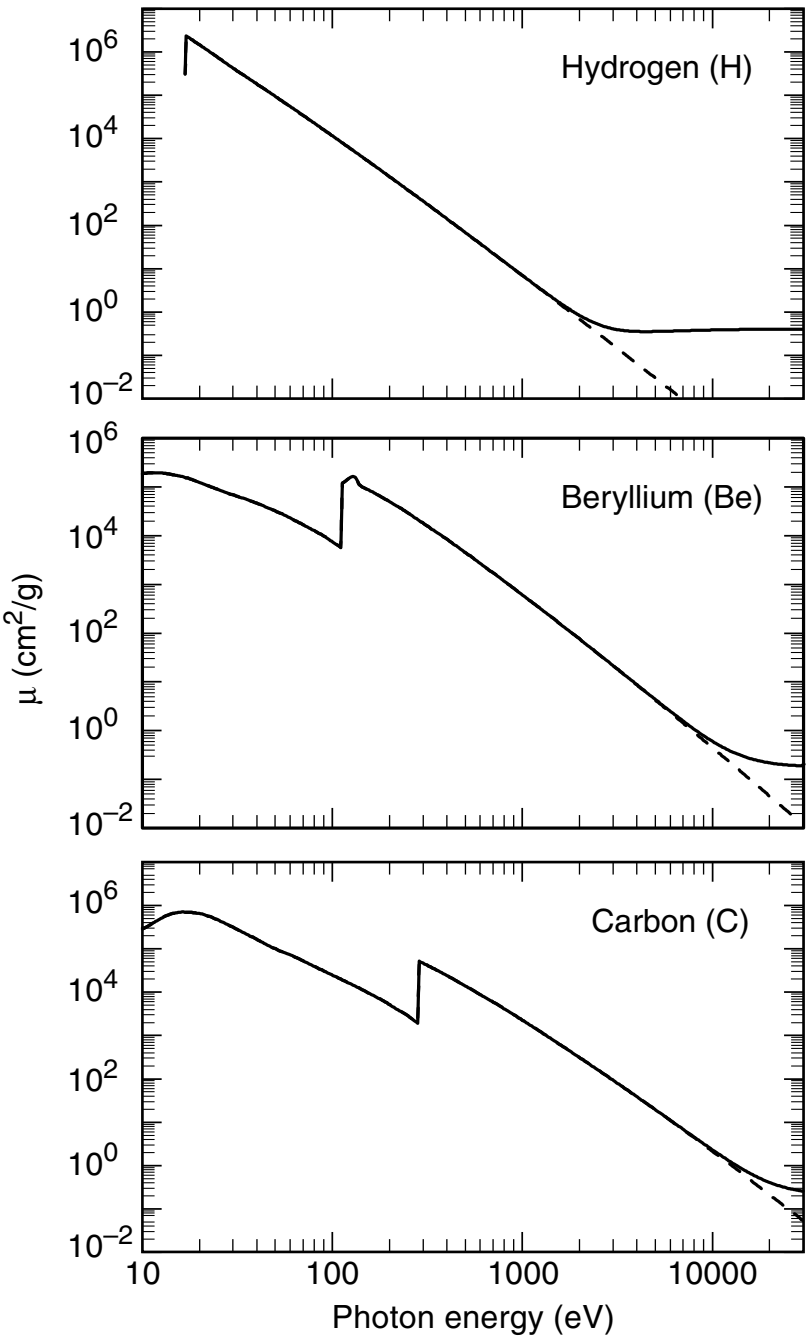

Fig. 1-5. *Plots of mass absorption coefficients for several elements in their natural forms. For H, Be, C, N, and O, the photoabsorption cross section is shown as a dashed curve.*

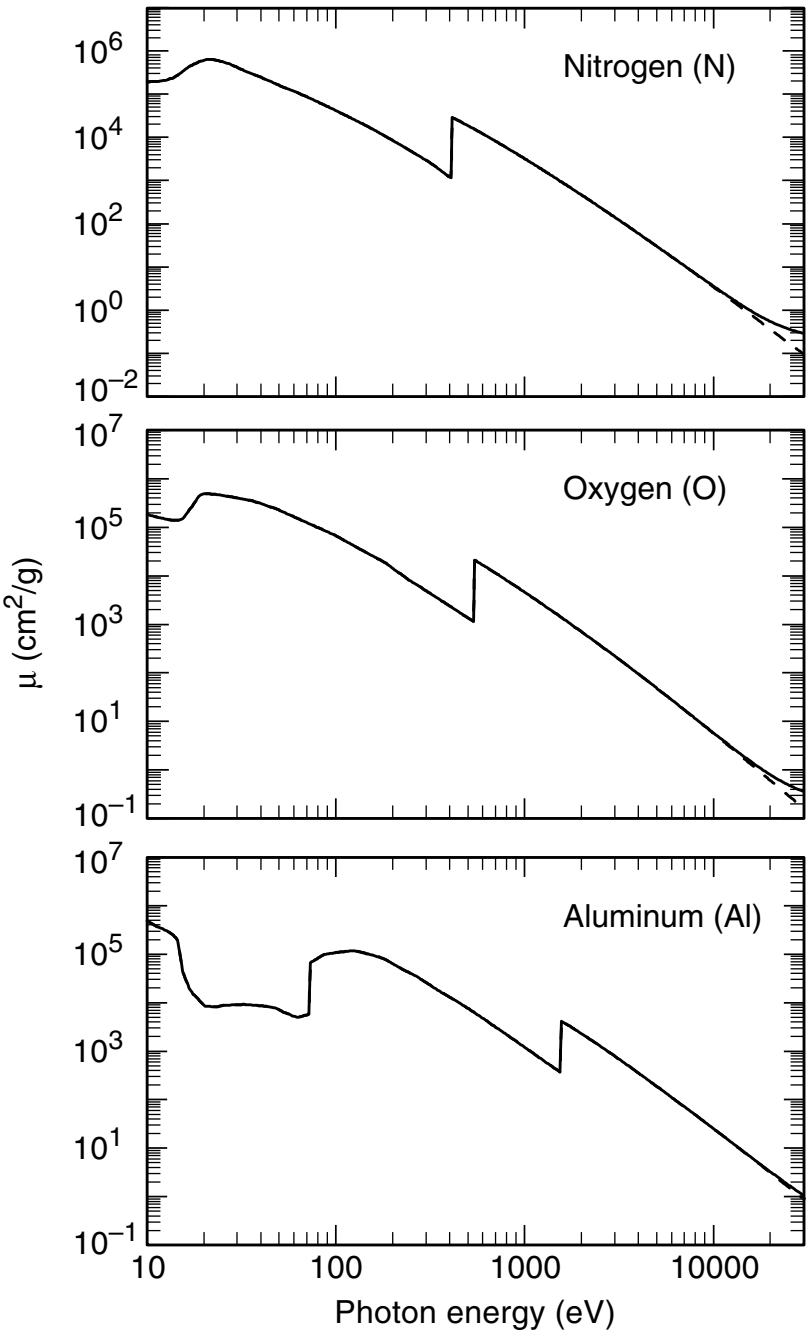

Fig. 1-5. *Mass absorption coefficients (continued).*

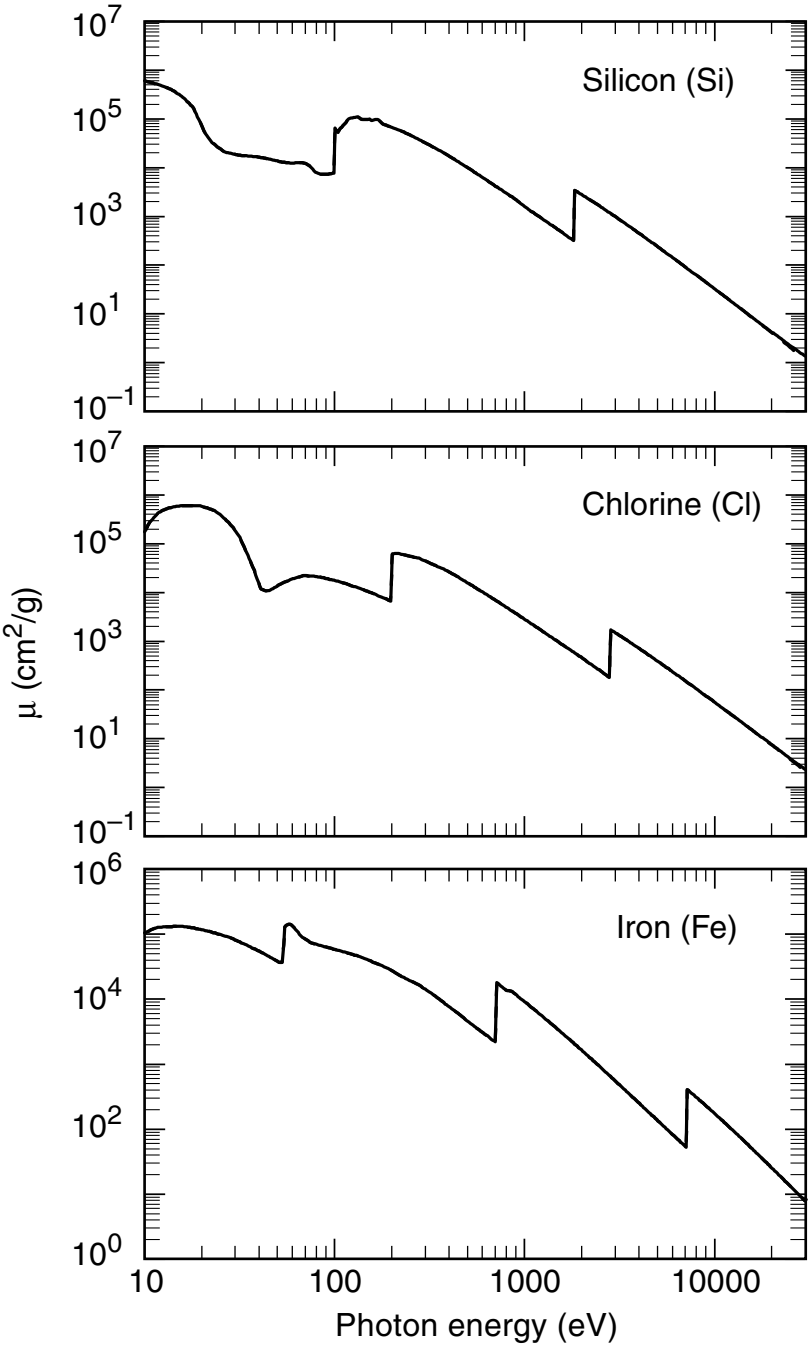

Fig. 1-5. *Mass absorption coefficients (continued).*

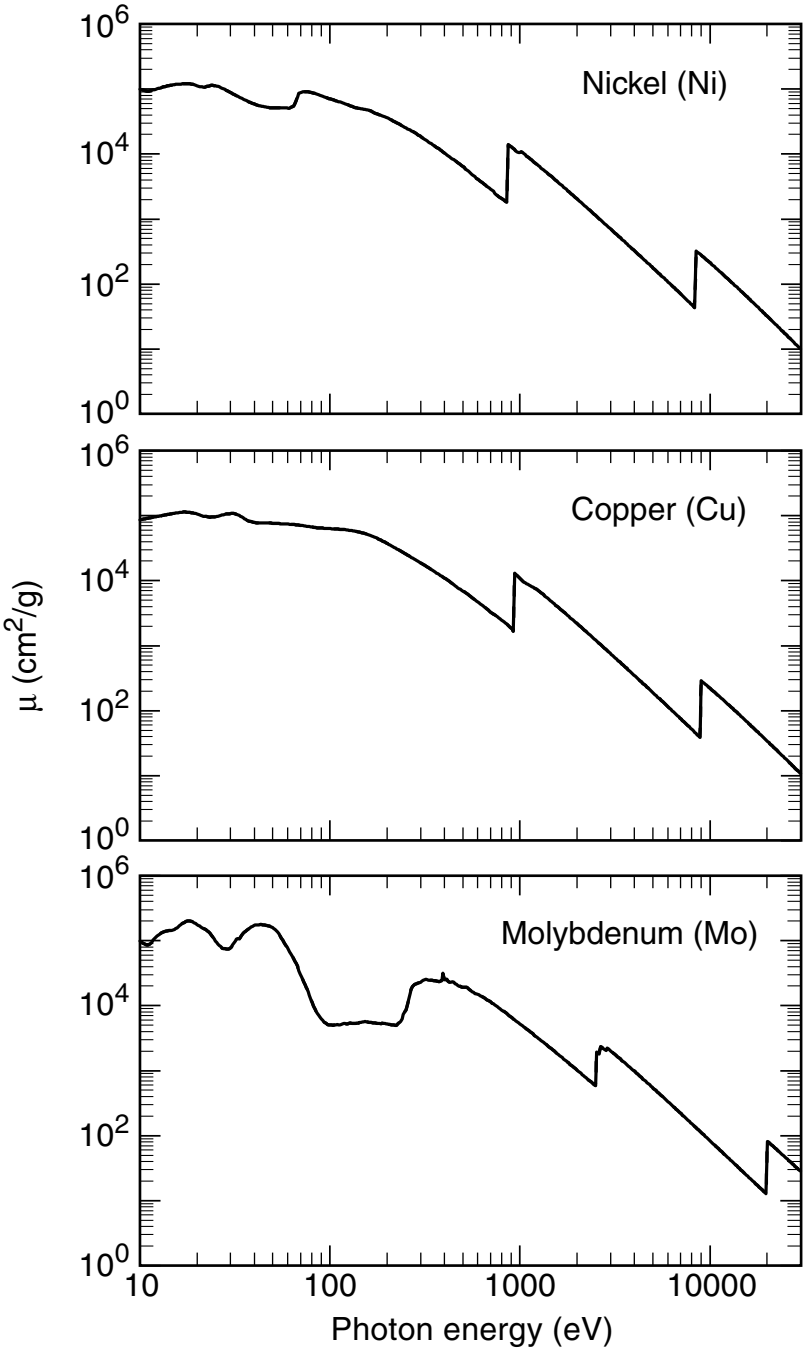

Fig. 1-5. *Mass absorption coefficients (continued).*

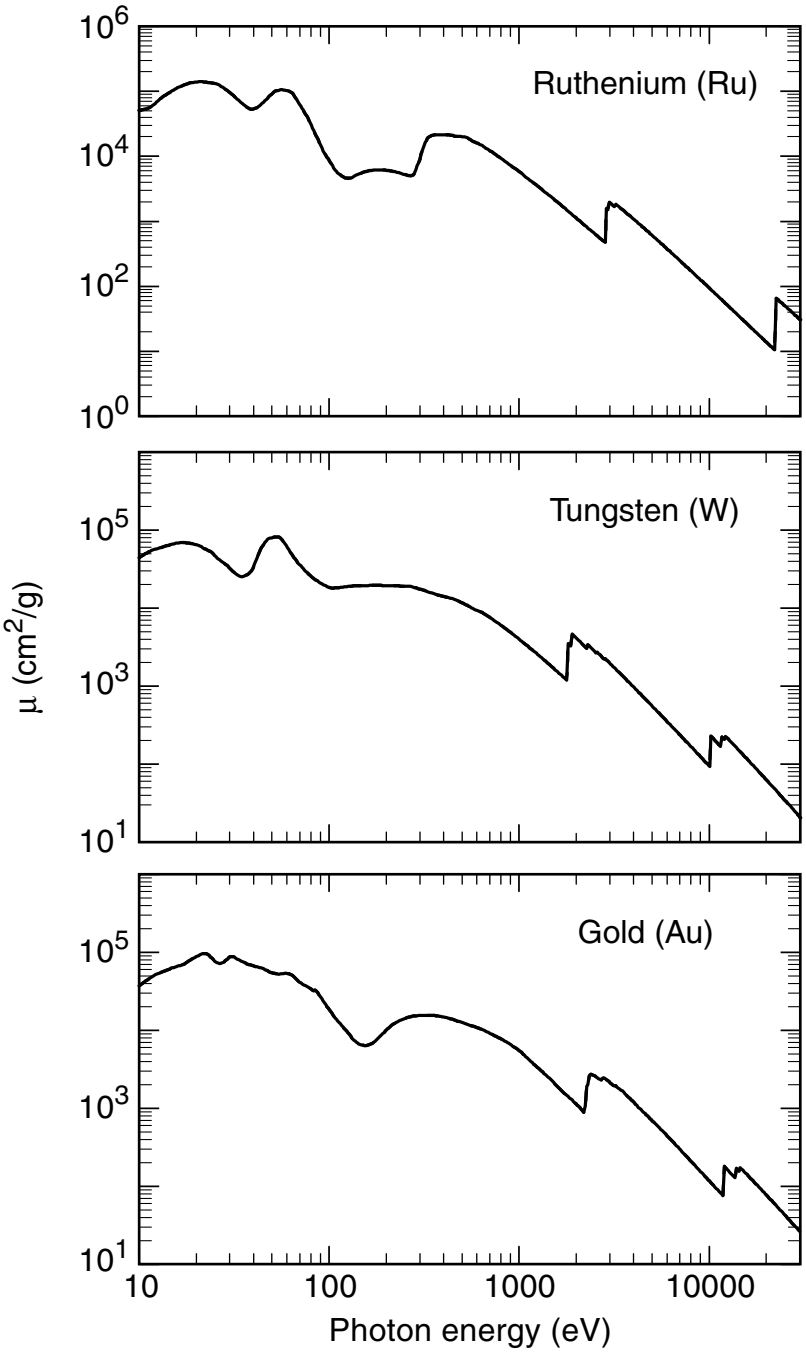

Fig. 1-5. *Mass absorption coefficients (continued).*